This is where the thesis title goes

— Your Name Here —

Centre for Astrophysics Research
— University of Hertfordshire —

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— March 2099 —

Acknowledgements

This template was not created by me (Neil Cook) though I added some functionality, commands and a lot of the comments, including this "readme". This template was passed on to me by Dr. Federico Marocco and was originally created by Dr. Kieran Forde (2007) and in various forms have been used by many of the astrophysics PhD students at the University of Hertfordshire.

Abstract

This is where the abstract goes. This document contains some useful information about using this thesis template.

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Å	Angstrom (1.0 $\times 10^{-10}$ m)
α,δ	Right Ascension and declination on the sky, measured in degrees
A_λ	Extinction at wavelength, λ
AU	Astronomical Unit (1.496 $\times 10^{11}$ m)
$A_{\rm v}$	Visual Extinction
β	The binary fraction
c	Speed of Light (3.0 x 10^8 m s^{-1})
$E(B-V)$	Colour Excess
g,r,i,z	SDSS photometric bands (centred at 0.46, 0.62, 0.66 and 0.89μm)
Gyr	10^9 yr
h	Planck Constant (6.62606896(33) $\times 10^{-34}$ m^2 kg s^{-1})
H_0	Hubble constant (72 km s^{-1}Mpc^{-1})
H_X	The reduced proper motion using photometric band X (i.e. $X = V$, $X = J$)
J,H,K_S	2MASS photometric bands (centred at 1.25, 1.65 and 2.16μm)
k_B	Boltzmann constant (1.3806504(24) $\times 10^{-23}$ J K^{-1})
λ	Wavelength
$log\, g$	A objects surface gravity, where g is measured in cgs units
μm	10^{-6} m
M_{jup}	Jupiter Mass (1.898 $\times 10^{27}$ kg)
Mpc	10^6 pc
$M_\odot$	Solar Mass (1.989 $\times 10^{30}$ kg)
μ,μ_α,μ_δ	The total proper motion and the proper motion components in α and δ, masured in arcsec yr^{-1}
M_X	The absolute magnitude (apparent magnitude at 10 pc) in photometric band X (i.e. $X = V$, $X = J$)

Myr	10^6 yr
pc	parsec (3.086×10^{16} m)
R_{jup}	Jupiter Radius (6.991×10^7 m)
$R_\odot$	Solar Radius (6.963×10^8 m)
σ	The uncertainty on a measurement (unless otherwise stated)
T_{eff}	A objects effective surface temperature in Kelvin, K
V	V band taken from the SDSS transformation
V_J	Johnson V magnitude derived from B_T and V_T
V_T, B_T	V band taken from the Tycho-2 catalogue.
$W1$,$W2$	WISE photometric bands (centred at 3.4 and 4.6μm)

Chapter 1: Introduction

1.1 Credit for this template

This template was not created by me (Neil Cook) though I added some functionality, commands and a lot of the comments, including this "readme". This template was passed on to me by Dr. Federico Marocco and was originally created by Dr. Kieran Forde (2007) and in various forms have been used by many of the astrophysics PhD students at the University of Hertfordshire.

1.1.1 File structure and contents

The following should be found within the extracted directory.

```
./appendices/
    appendixA.tex
    appendixB.tex
./chapters/
    ch_1.tex
    ch_2.tex
./figures/
    phd_comics_example.jpg
    phd_comics_example1.jpg
./footers/
    1.jpg
    2.jpg
    ...
    225.jpg
./latex_resources/
    /comment/     package from CTAN.org
    /glossary/    package from CTAN.org
    /mfirstuc/    package from CTAN.org
    /sidecap/     package from CTAN.org
    /tocloft/     package from CTAN.org
    makeindex
./preamble/
    Abstract.tex
    acknowledgement_refs.tex
```

```
        Acknowledgements.tex
        glossary.tex
        newcommands.tex
        symbols.tex
        titlepage.tex
    ./referencing/
        article_names.tex
        astroads.bst
        Bibliography.bib
    ./tables/
        ch1_table_example1.tex
        ch1_table_example2.tex
        ch1_table_example_landscape.tex
    compile
    main.pdf
    main.tex
    phd.cls
```

1.2 Installation and running code

1.2.1 The compiler

You will not be able to just run "pdflatex" or "latex" to compile this LaTeXdocument, thus you will need to run the "compile" file (`./compile`).

The compile file runs the following set of programs (defined below) in this specific order:

```
    $LATEX "$rootPath"

    $BIBTEX "$rootPath"

    $MKGLOS "$rootPath"

    $MKINDX "$rootPath"".idx"

    $MKINDX -s "$rootPath"".ist" -t "$rootPath"".glg"
               "$rootPath"".glo" -o "$rootPath"".gls"
```

```
$MKINDX -s "$rootPath"".ist" -t "$rootPath"".nlg"
          "$rootPath"".not" -o "$rootPath"".ntn"

$LATEX "$rootPath"

$LATEX "$rootPath"

$MKINDX "$rootPath"".idx"

$MKINDX -s "$rootPath"".ist" -t "$rootPath"".glg"
          "$rootPath"".glo" -o "$rootPath"".gls"

$MKINDX -s "$rootPath"".ist" -t "$rootPath"".nlg"
          "$rootPath"".not" -o "$rootPath"".ntn"

$LATEX "$rootPath"
```

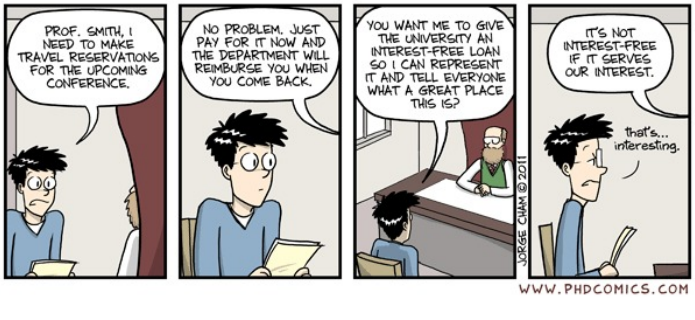
Before the first run you will need to edit some of the paths so that the compiler can use LATEX/BIBTEX/MKINDX/MKGLOS correctly (and open the file after running)

```
#!/bin/sh

### ===============================================
### --->  You will need to change this stuff to
          compile the document
### ===============================================
### --->  Commands  <--- ###
LATEX=/usr/bin/pdflatex
BIBTEX=/usr/bin/bibtex
OPEN="/usr/bin/okular --unique "
### --->  Users Files  <--- ###
rootDoc=./
rootPath=main

### ===============================================
### --->  _Don't_ change anything past here
### ===============================================
```

When you open `./compile` these are the only lines that may need changing. "LATEX"



is the path to pdflatex or latex. To find out where this should be pointing type

```
which pdflatex
```

into a terminal. This is the same for "BIBTEX" (but with bibtex instead of pdflatex). "OPEN" defines the way to open a pdf. I use okular but you can just use "gnome-open" instead of "/usr/bin/okular –unique" to open with the gnome default pdf program.

NOTE: after compiling all temp files are moved to a "trash" folder located at ./trash/, this can be turned off (or made optional) by editing the end of the compile file.

1.2.2 Modifying you TeX path

For this installation to work you will need to make sure LaTeXcan see the ./latex_resources/ folder (or that that contents of ./latex_resources/ is copied to the LaTeXpath).

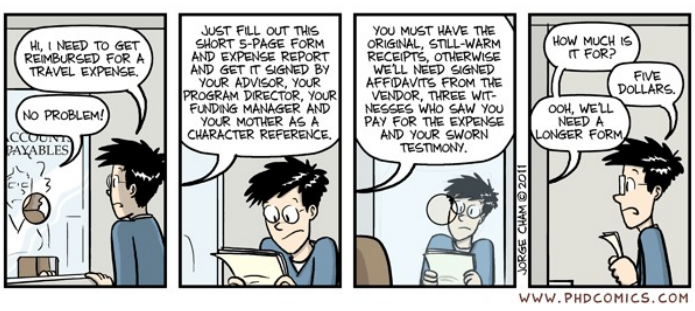
This can be done by adding the PATH/latex_resources/ to the "TEXINPUTS" and "TEXMFHOME" environment paths i.e. using tcsh in the ~/.login one could add:

```
setenv TEXINPUTS .:{PATH TO DIR}/latex_resources/
                 :/usr/share/texmf/tex/latex//

setenv TEXMFHOME {PATH TO DIR}/latex_resources//
```

WARNING: If "TEXINPUTS" and "TEXMFHOME" exist before using the previous two commands will override your current paths. So please check the paths before replacing them (i.e. using "printenv TEXINPUTS") and then if they exist using:

```
setenv TEXMFHOME {PATH TO DIR}/latex_resources//:{$TEXMFHOME}
```



Object	M	σ_M	R	σ_R
A132	9.06e-01	9.52e-01	8.63e-01	9.29e-01
A435	1.18e+00	1.09e+00	1.24e+00	1.11e+00
A667	3.13e-01	5.60e-01	9.70e-01	9.85e-01
A902	1.94e+00	1.39e+00	9.72e-01	9.86e-01
B231	2.76e-01	5.26e-01	1.02e+00	1.01e+00
B601	1.30e+00	1.14e+00	8.02e-01	8.95e-01
C023	5.37e-01	7.33e-01	1.01e+00	1.01e+00
C027	5.98e-01	7.74e-01	1.06e+00	1.03e+00
C512	6.73e-01	8.21e-01	8.38e-01	9.15e-01
C920	1.45e+00	1.21e+00	9.84e-01	9.92e-01
D012	1.50e+00	1.22e+00	1.33e+00	1.15e+00
D312	1.35e+00	1.16e+00	1.05e+00	1.02e+00
D442	1.35e+00	1.16e+00	8.53e-01	9.24e-01
D620	9.65e-01	9.83e-01	9.70e-01	9.85e-01
D920	1.09e+00	1.04e+00	7.79e-01	8.83e-01

Table 1.1: This is a example table using the input table command

1.3 Some useful information

1.3.1 Using table commands

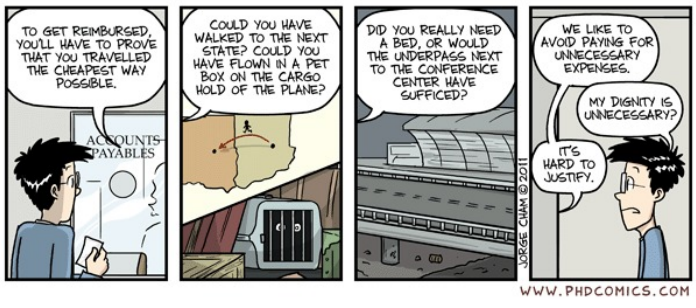
The Input table command

These commands are an alternate way to add a table to your LaTeXfile (One could use the "input" command as well). The basic form of this command requires a reference (which also doubles as the file name) and a caption. i.e. the table "ch1_table_example1" acts both as the reference to call with the "ref" function and as the file name containing (thus tables must be placed in `./tables/` i.e. `./tables/ch1_table_example1.tex`). A variant of this is the "inputtableS" which allows a short caption as well as the full caption (for the list of tables, and is equivalent to using the square brackets in caption). See Table 1.1 and Table 1.2 for example tables.

```
\inputtable{ref}{full caption}
\inputtableS{ref}{short caption}{full caption}
```

The content of the .tex file is a tabular environment i.e. :

```
\begin{tabular}{ccc}
    \hline
    Object & M & $\sigma_{M}$ \\
    \hline
    A132 & 9.06e-01 & 9.52e-01 \\
    \hline
```



Object	M	σ_M	R	σ_R
A132	9.06^{-01}	9.52^{-01}	8.63^{-01}	9.29^{-01}
A435	1.18^{+00}	1.09^{+00}	1.24^{+00}	1.11^{+00}
A667	3.13^{-01}	5.60^{-01}	9.70^{-01}	9.85^{-01}
A902	1.94^{+00}	1.39^{+00}	9.72^{-01}	9.86^{-01}
B231	2.76^{-01}	5.26^{-01}	1.02^{+00}	1.01^{+00}
B601	1.30^{+00}	1.14^{+00}	8.02^{-01}	8.95^{-01}
C023	5.37^{-01}	7.33^{-01}	1.01^{+00}	1.01^{+00}
C027	5.98^{-01}	7.74^{-01}	1.06^{+00}	1.03^{+00}
C512	6.73^{-01}	8.21^{-01}	8.38^{-01}	9.15^{-01}
C920	1.45^{+00}	1.21^{+00}	9.84^{-01}	9.92^{-01}
D012	1.50^{+00}	1.22^{+00}	1.33^{+00}	1.15^{+00}
D312	1.35^{+00}	1.16^{+00}	1.05^{+00}	1.02^{+00}
D442	1.35^{+00}	1.16^{+00}	8.53^{-01}	9.24^{-01}
D620	9.65^{-01}	9.83^{-01}	9.70^{-01}	9.85^{-01}
D920	1.09^{+00}	1.04^{+00}	7.79^{-01}	8.83^{-01}

Table 1.2: This is a example table using the input table command (with a short caption in the list of tables)

```
\end{tabular}
```

Landscape table

"inputtable" also works in landscape (as see below), this landscape command also works with native LaTeXtable environments.

```
\begin{landscape}
\inputtable{reference and filename}{full caption}
\end{landscape}
```

Continued table

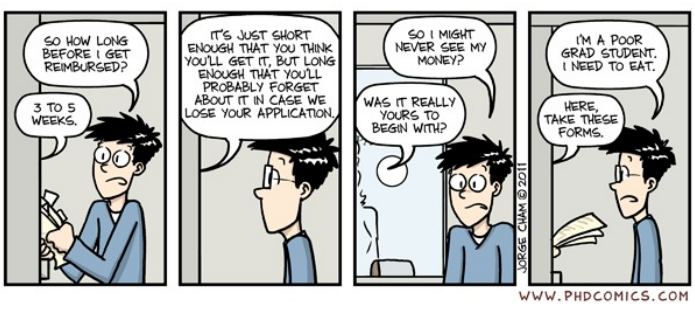
In addition one can add a continued table as two smaller tables using the "inputtableC" command, just call the table as normal ("inputtable") for the first page and then add the second table using the "inputtableC", this will use the numbering of the first table on the second (see Table 1.3 for an example).

```
\begin{landscape}
\inputtable{reference and filename}{full caption}
\end{landscape}

\begin{landscape}
```

```
\inputtableC{reference and filename}{Continued table}
\end{landscape}
```

An example of these table commands can be seen in Table 1.3 (note landscape tables start a new page at the location the command is used and may lead to white space. One can generally just put the table later to avoid this if it is unwanted).

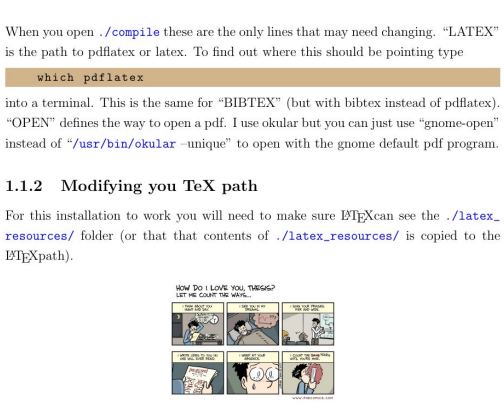


Object	M	σ_M	R	σ_R	L	σL	P	σP
A132	9.06^{-01}	9.52^{-01}	8.63^{-01}	9.29^{-01}	3.02^{+10}	1.74^{+05}	1.75^{-01}	4.18^{-01}
A435	1.18^{+00}	1.09^{+00}	1.24^{+00}	1.11^{+00}	3.04^{+10}	1.74^{+05}	2.17^{-01}	4.65^{-01}
A667	3.13^{-01}	5.60^{-01}	9.70^{-01}	9.85^{-01}	3.04^{+10}	1.74^{+05}	2.01^{-01}	4.48^{-01}
A902	1.94^{+00}	1.39^{+00}	9.72^{-01}	9.86^{-01}	3.00^{+10}	1.73^{+05}	2.26^{-01}	4.76^{-01}
B231	2.76^{-01}	5.26^{-01}	1.02^{+00}	1.01^{+00}	3.01^{+10}	1.74^{+05}	2.43^{-01}	4.93^{-01}
B601	1.30^{+00}	1.14^{+00}	8.02^{-01}	8.95^{-01}	3.00^{+10}	1.73^{+05}	2.25^{-01}	4.75^{-01}
C023	5.37^{-01}	7.33^{-01}	1.01^{+00}	1.01^{+00}	3.02^{+10}	1.74^{+05}	2.34^{-01}	4.84^{-01}
C027	5.98^{-01}	7.74^{-01}	1.06^{+00}	1.03^{+00}	3.02^{+10}	1.74^{+05}	1.70^{-01}	4.12^{-01}
C512	6.73^{-01}	8.21^{-01}	8.38^{-01}	9.15^{-01}	2.96^{+10}	1.72^{+05}	2.03^{-01}	4.51^{-01}
C920	1.45^{+00}	1.21^{+00}	9.84^{-01}	9.92^{-01}	2.97^{+10}	1.72^{+05}	2.00^{-01}	4.47^{-01}
D012	1.50^{+00}	1.22^{+00}	1.33^{+00}	1.15^{+00}	3.01^{+10}	1.73^{+05}	2.18^{-01}	4.67^{-01}
D312	1.35^{+00}	1.16^{+00}	1.05^{+00}	1.02^{+00}	2.99^{+10}	1.73^{+05}	1.73^{-01}	4.16^{-01}
D442	1.35^{+00}	1.16^{+00}	8.53^{-01}	9.24^{-01}	2.95^{+10}	1.72^{+05}	2.11^{-01}	4.59^{-01}
D620	9.65^{-01}	9.83^{-01}	9.70^{-01}	9.85^{-01}	3.02^{+10}	1.74^{+05}	2.95^{-01}	5.43^{-01}
D920	1.09^{+00}	1.04^{+00}	7.79^{-01}	8.83^{-01}	3.02^{+10}	1.74^{+05}	1.78^{-01}	4.21^{-01}

Table 1.3: This is a example landscape table using the input table command

Object	M	σ_M	R	σ_R	L	σL	P	σP
A132	9.06^{-01}	9.52^{-01}	8.63^{-01}	9.29^{-01}	3.02^{+10}	1.74^{+05}	1.75^{-01}	4.18^{-01}
A435	1.18^{+00}	1.09^{+00}	1.24^{+00}	1.11^{+00}	3.04^{+10}	1.74^{+05}	2.17^{-01}	4.65^{-01}
A667	3.13^{-01}	5.60^{-01}	9.70^{-01}	9.85^{-01}	3.04^{+10}	1.74^{+05}	2.01^{-01}	4.48^{-01}
A902	1.94^{+00}	1.39^{+00}	9.72^{-01}	9.86^{-01}	3.00^{+10}	1.73^{+05}	2.26^{-01}	4.76^{-01}
B231	2.76^{-01}	5.26^{-01}	1.02^{+00}	1.01^{+00}	3.01^{+10}	1.74^{+05}	2.43^{-01}	4.93^{-01}
B601	1.30^{+00}	1.14^{+00}	8.02^{-01}	8.95^{-01}	3.00^{+10}	1.73^{+05}	2.25^{-01}	4.75^{-01}
C023	5.37^{-01}	7.33^{-01}	1.01^{+00}	1.01^{+00}	3.02^{+10}	1.74^{+05}	2.34^{-01}	4.84^{-01}
C027	5.98^{-01}	7.74^{-01}	1.06^{+00}	1.03^{+00}	3.02^{+10}	1.74^{+05}	1.70^{-01}	4.12^{-01}
C512	6.73^{-01}	8.21^{-01}	8.38^{-01}	9.15^{-01}	2.96^{+10}	1.72^{+05}	2.03^{-01}	4.51^{-01}
C920	1.45^{+00}	1.21^{+00}	9.84^{-01}	9.92^{-01}	2.97^{+10}	1.72^{+05}	2.00^{-01}	4.47^{-01}
D012	1.50^{+00}	1.22^{+00}	1.33^{+00}	1.15^{+00}	3.01^{+10}	1.73^{+05}	2.18^{-01}	4.67^{-01}
D312	1.35^{+00}	1.16^{+00}	1.05^{+00}	1.02^{+00}	2.99^{+10}	1.73^{+05}	1.73^{-01}	4.16^{-01}
D442	1.35^{+00}	1.16^{+00}	8.53^{-01}	9.24^{-01}	2.95^{+10}	1.72^{+05}	2.11^{-01}	4.59^{-01}
D620	9.65^{-01}	9.83^{-01}	9.70^{-01}	9.85^{-01}	3.02^{+10}	1.74^{+05}	2.95^{-01}	5.43^{-01}
D920	1.09^{+00}	1.04^{+00}	7.79^{-01}	8.83^{-01}	3.02^{+10}	1.74^{+05}	1.78^{-01}	4.21^{-01}

Table 1.3 (cont.): This is a example landscape table using the input table command



When you open `./compile` these are the only lines that may need changing. "LATEX" is the path to pdflatex or latex. To find out where this should be pointing type

```
which pdflatex
```

into a terminal. This is the same for "BIBTEX" (but with bibtex instead of pdflatex). "OPEN" defines the way to open a pdf. I use okular but you can just use "gnome-open" instead of "`/usr/bin/okular` –unique" to open with the gnome default pdf program.

1.1.2 Modifying you TeX path

For this installation to work you will need to make sure LaTeXcan see the `./latex_resources/` folder (or that that contents of `./latex_resources/` is copied to the LaTeXpath).

(a)

(b)

Figure. 1.1: Example side by side figure (a) The cartoon footer in the page (b) the jpg file in the `./footers` folder.

1.3.2 Cartoon footnotes (for supervisors that get bored quickly)

I was asked by one supervisor to add a cartoon to the bottom of every page (to make it more "enjoyable" to read), a very strange request that may not be repeated but this is a pretty cool bit of LaTeXcode. It requires a folder called `./footers` in which cartoons are stored as ".jpg" files with only a number (corresponding to the page number).

```
\fancyfoot[C]{\includegraphics[height=4cm]
                {./footers/\arabic{page}.jpg}}

\setlength{\textheight}{22.5cm}
```

These lines can just be commented out to remove this from the document as it increases the size of the footers substantially. Figure 1.1 Shows two examples of this document with the footers in place.

NOTE: To turn off the cartoons (enabled by default) just comment out these lines in `./main.tex`.

```
\fancyfoot[C]{\includegraphics[height=4cm]
                {./footers/\arabic{page}.jpg}}
```

```
\setlength{\textheight}{22.5cm}
```

1.3.3 Indexing

There are multiple ways to use the indexing. I use two commands to save on space.

```
\define{key}
```

displays the word in the text and adds it to the index. Note that keys are case sensitive and thus will appear multiple times in the index (define also auto capitalises index words so normally I just use the lowercase in the text)

```
\defineas{word}{key}
```

displays 'word' in the text and adds a different word to the key. An example of when this may be useful is the case where you need a capital word in the text or a word such as 'photometric', where you only wish to have 'photometry' in the index.

```
\index{key}
```

puts the key in the index. This requires you to put the word in the text separately. Examples of the use are below:

```
The \define{star} was found by using the
\defineas{photometric}{photometry} bands,
this was useful to judge contamination
\index{contamination}.
```

This adds the words 'star', 'photometry' and 'contamination' to the index (with a page reference to this page).

1.3.4 Using the glossary

I use a glossary to define terms such as 2MASS, WISE, NIR or SNR. These words will only appear in the glossary when one of the following commands is used:

```
\acro{key}
```

displays the word in the text, and adds the key to the glossary and the index.

```
\useglosentry{key}
```

adds the key only to the glossary only.

1.3.5 Using acknowledgement citations

This can be used in any LaTeX document, basically reduces acknowledgements down in to citing the correct survey/telescope or word (acknowledgement terms are stored in ./preamble/acknowledgement_refs.tex)

The can then be used anywhere (i.e. at the end of a chapter) using the following command:

```
\acknowledge{key}
```

an example of this is as follows:

```
\acknowledge{2MASS}
\acknowledge{WISE}
```

And would produce the following text:

This thesis makes use of data products from the Two Micron All Sky Survey(Skrutskie et al., 2006), which is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation.

This thesis makes use of data products from the Wide-field Infrared Survey Explorer(Wright et al., 2010), which is a joint project of the University of California, Los Angeles, and the Jet Propulsion Laboratory/California Institute of Technology, funded by the National Aeronautics and Space Administration.

Note you can change the word 'thesis' for all acknowledgements at the top of the ./preamble/acknowledgement_refs.tex file.

Adding new acknowledgements

New acknowledgements are set up similar to bibtex files. In ./preamble/acknowledgement_refs.tex keys are set up as follows:

```
\pgfkeys{/APLpy/.code = {This \acknowledgetype made use of
                         APLpy, an open-source plotting
                         package for Python hosted at
                         \url{http://aplpy.github.com}.}}
```

where

```
\acknowledgetype
```

is set near the start of ./preamble/acknowledgement_refs.tex

```
\newcommand{\acknowledgetype}{thesis\,\,}
```

editing the text in red in the above will change all acknowledgements to use this instead of thesis (see above).

1.3.6 Referencing Figures, Tables and Sections

These are short cuts to writing "Figure X", "Table Y", "Section Z" and are edited in the ./preamble/newcommands.tex.

These are defined for a figure:

```
\reffig{reference}
```

the above is an alias of:

```
Figure \ref{reference}
```

A table:

```
\reftab{reference}
```

the above is an alias of:

```
Table \ref{reference}
```

And a section:

```
\refsec{reference}
```

the above is an alias of:

```
Section \ref{reference}
```

These aliases can be changed in ./preamble/newcommands.tex:

```
%referencing sections, figures, tables, equations
\newcommand{\reffig}[1]{Figure \ref{#1}}
\newcommand{\reftab}[1]{Table \ref{#1}}
\newcommand{\refequ}[1]{Equation \ref{#1}}
\newcommand{\refsec}[1]{Section \ref{#1}}
```

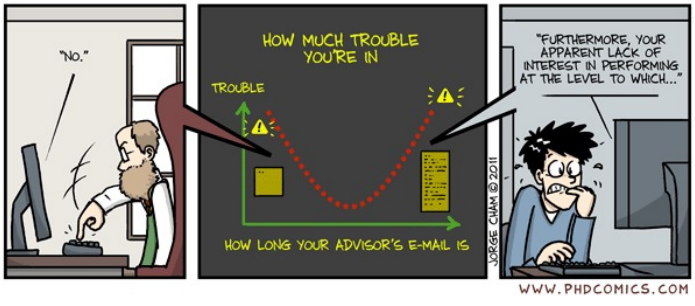
i.e. replacing Figure with Fig. will change every instance of reffig.

An example of each is shown below:

```
\reffig{ch1_figure_1} shows x against y
(from \refsec{ch1_section_2}) and
is also shown in \reftab{ch1_table_3}.
```

This would give the following text:

Figure 1 shows x against y (from Section 1.2) and is also shown in Table 3.



Chapter 2: The second chapter

2.1 First section of Chapter 2

2.2 First subsection of Chapter 2

References

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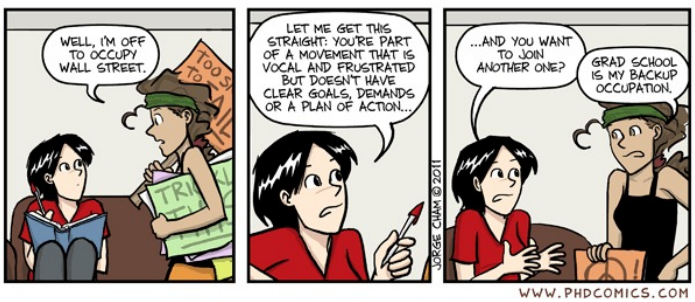

Glossary

2MASS The Two (**2**) **M**icron **A**ll **S**ky **S**urvey (implied point source catalogue) is an all-sky near-infrared (J, H, K_S) catalogue of 470 992 970 objects from Skrutskie et al. (2006)

NIR The **N**ear **I**nfrared **R**ed is the wavelength region from $\sim$0.7/0.8 to 2.5μm in the electromagnetic spectrum.

SNR The **S**ignal to **N**oise **R**atio, or S/N is a measure of quality of some data compared to its uncertainties.

WISE The **W**ide-Field **I**nfrared **S**urvey **E**xplorer is a space based near-to-mid infrared telescope (3.4, 4.6, 12 and 22 μm), the all-sky source catalogue contains 563 921 584 objects (Wright et al., 2010).

Appendix A: Appendix A

Test

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